

X. *Further Remarks on the Organs found on the bases of the Halteres and Wings of Insects.* By J. B. HICKS, Esq., M.D. Lond., F.L.S.

Read June 2nd, 1857.

IN a former paper, published in the Journal of the Linnean Society*, I endeavoured to describe a curious and beautiful structure to be observed at the base of the halteres of the *Diptera*, and a similar but less elaborate condition on the subcostal nervures of the wings of both *Diptera* and other insects, and stated that generally the organs in question on the posterior wings of the 4-winged tribes were the more numerous. I also proceeded to show, that into the halteres, as also into each of the wings of insects in general, could be traced a nerve of considerable size, varying in the different tribes and genera in that particular, and that the nerve proceeding to the posterior wings was generally the larger, and also that the one supplying the halteres of the Blow- and Drone-fly was the largest nerve in the insect, except the optic. I may here repeat, that each of these structures consists of very thin and transparent, hemispherical, or more nearly spherical projections from the cuticular surface, beneath which the wall of the nervure is deficient, so as to allow a free communication with its interior; these organs are arranged in rows on the halteres, and in variously shaped groups in the wings. I concluded that the nerve proceeded to these structures, inasmuch as there was no muscle in the wing or halteres, and that consequently the nerve must be one of sensation; and looking at the elaborate and regular disposition of the structures composing it, I was induced to think the organ was one of special sensation, and that, situated as it was near the great thoracic spiracle, as well as exposed to constant and rapid currents of air, it seemed not improbable that it was connected with the olfactory sense.

At that time I had not been able to prove the actual connexion between the nerve and these vesicles, but I have now the pleasure of exhibiting a drawing (Tab. XXVII. fig. 1) made from a specimen which I have preserved, showing most distinctly the nerve in its whole course, giving off in its passage by the groups of vesicles, numerous branches which can be traced into their bases. This may be seen by any one taking due care in the preparation of the specimen. The drawing is from the second wing of a Longicorn beetle (*Strangalia elongata*); though perhaps every wing will not show it well, on account of the position of the nervures. I may here mention the method employed, which is one, I believe, frequently in use:—After cutting off the wing and washing it well in water or spirits of wine, and draining off the major part by blotting-paper, I immerse it in spirits of turpentine for a week or two, after which it is placed in Canada balsam between glass in the usual way, taking care not to heat it, as that renders the nerve too transparent. In those parts which are too dark for observation, I have been enabled to render them colourless by chlorine: a little chlorate of potash, and a few drops of hydrochloric acid,

* Vol. i. p. 136, Nov. 1, 1856.

mixed in a small bottle, with the addition of a little water when the effervescence is brisk, will in a short time remove sufficiently the colour of most insects. Some parts which are quite black, as the elytra of beetles, wings of bees, &c., require a day or two, and some even a week. The hydrochloric acid has also a valuable property in rendering the nerve-tubes more perceptible. This plan of bleaching will be found invaluable in examining the structure of antennæ, which are often quite black, as I shall hereafter show.

I have also shown the distribution of the nerve in the wing of *Tenthredo viridis*: the bundle of nerves going to the vesicles was well marked in the specimen from which the drawing was taken.

These examples will, I think, serve to point out the intimate connexion between the vesicles and the nerves. Whether the whole nerve be distributed, in all instances, to these organs, I am inclined to doubt, since a small branch seems to pass beyond the point where they cease.

I shall now endeavour to trace these organs through the different tribes, so far as I have been able.

In the *Hymenoptera* I find that they exist far more extensively than I supposed when my former paper was read; their detection has been mainly owing to the use of chlorine, so few of this Order having light-coloured nervures in the wings. The figures here given represent these organs in *Ophion luteus* (Tab. XXVIII. fig. 2) and *Tenthredo viridis* (Tab. XXVIII. fig. 3), two species which are good examples of the tribe, and in which the nervures are the most transparent. These organs in the Wasp (*Vespa vulgaris*), Honey-bee (*Apis mellifica*), *Andrena fulvicans*, and *Tenthredo lucorum*, having a great resemblance to the above, I have not thought it worth while to figure them.

They consist of two groups on the upper, and one scattered group on the under side of the subcostal nervure, amounting in *Ophion* to 200–300 above, and perhaps 100 beneath, with a smaller group at the end of the nervure.

With regard to the *Diptera* I have nothing to add to my former remarks, excepting that I have found the vesicles in *Hippobosca equina* distinctly marked both in the halteres and wings. The diameter of each vesicle is $\frac{1}{2360}$ inch.

In *Tipula oleracea* they are also well shown on the wings.

In the *Hemiptera* they are very scanty; I have observed and drawn those on the second wing of the Tree Bug, a species of *Pentatoma*.

In *Notonecta glauca*, or the Water-boatman, they are even more simple.

In *Corysus* I have been unable to find them. I have carefully examined the elytra of the common Bed-Bug (*Cimex lectularius*), but cannot find anything definite; some papillæ occur on them, but they do not seem to be arranged in any distinctive manner.

In the Coleopterous group we find them highly developed, as may be observed in the drawing of these organs in *Strangalia elongata* in Plate XXVII. fig. 1.

They occur in numerous groups on the subcostal nervure, mostly at the widest part, but are also scattered along it to the joint of the wing, where we find about ten or twelve large vesicles in a group, after which they cease.

In the Carrion Beetles (*Necrophorus*) they are very well developed, as also in *Silpha*, where they are remarkably large, considering the size of the insect.

In *Lucanus Cervus*, *Melolontha vulgaris*, and *Cetonia aurata* they are not so large, but still are numerous.

In *Carabus granulatus* they are found in the rudimentary second wing, more diffused over it than in some other genera, inasmuch as other nervures than the subcostal are furnished with them, though not to the same extent.

In an apterous Beetle which I examined, I did not find any similar organs on the part of the side corresponding to the position of the wings.

With regard to the distribution of the nerve in the elytron of the *Coleoptera*, there are some curious facts, which, I think, have not been hitherto noticed. If the elytron be treated in the way above mentioned, and first bleached if it be dark-coloured, the branching tracheæ will at once be recognized, accompanied by the nerve, which gives out branches as it proceeds. Now, in all the elytra of beetles I have examined, there is a number of distinct projections from the whole dorsal surface, in many hemispherical, in some like small papillæ just raised above the cuticular surface; these eminences are arranged in a tolerably regular manner, and are quite distinct from other irregularities of surface. The hemispherical forms are very transparent, the wall of the elytron being deficient beneath them, as in those before described. There are two or three papillæ at the highest point of the vesicle. Some, when viewed by polarized light, exhibit a dark cross, something after the manner of starch-cells; those of *Melolontha* show it well.

In many beetles the vesicle or papilla is accompanied by a hair, which always, I believe, when so situated, overarches it, as if for the purpose of affording protection.

Now, into each of these vesicles and papillæ a branch of the nerve can be distinctly traced, as I have shown in the two drawings taken from *Melolontha* (Tab. XXVII. fig. 2) and *Carabus* (Tab. XXVIII. fig. 1). In the case of *Melolontha* the hair may be seen overarcheing the vesicle.

With regard to the *Lepidoptera* I have found nothing new, except that the organs are well developed in the female Vapourer Moth (*Orgyia*) on the rudimentary wing.

In none of the Orthopterous specimens hitherto examined have I been able to find any structure like that described in the other groups. A nerve, small in some, but large in *Mantis religiosa*, is to be found entering the wings, yet I have been unable to make out anything satisfactory, except a few scattered vesicles on one or two of the nervures.

In the *Neuroptera* these organs can be distinctly found, though not quite so fully developed as in most of the preceding groups. In *Libellula depressa* they are not, relatively to the size of the insect, by any means so numerous as in the *Coleoptera*. I have drawn those of *Agrion*, where they are but few; and those of *Phryganea*, which are rather more simple. In the Flea (*Pulex irritans*), I have been unable to detect anything connected with this subject.

I have not been able to distinguish any difference between the sexes in reference to these structures, their relative size corresponding to that of the individual, which is generally larger in the female. The species of a given genus, especially of the Dipterous group, exhibit a marked similarity in the appearance of these organs; so that it is possible, by examining them, to tell to what genus any Fly, whose halteres are presented to you, belongs.

In regard to their relative development in the various Orders, so far as I have already gone, I am enabled to say, that they are most perfect in the *Diptera*, next so in the *Coleoptera*, rather less so in the *Lepidoptera*, but slightly developed in the *Neuroptera*, scarcely at all in the *Orthoptera* (though this assertion may be hereafter modified), and that only a trace of them exists in the *Hemiptera*.

I have found in each of those divisions the most numerous and largest organs in those insects which are notorious for their acute scent, *ex. gr.* in the Carrion Beetles, Blow-flies, and *Bombycidae*, and the smallest and fewest in those that are either very sluggish in habit, as the Bugs; or in those that hunt their prey by sight, as the *Libellulae*; or those having a large development of the eye, as *Tabanus*, &c.

Note.—Since the above paper was read, I have been favoured, through the kindness of Mr. J. O. Westwood, with the following extracts from Keller's 'Geschichte der gemeinen Stubenfliege' (pp. 22, 23), taken from copies of the two versions in the Hopeian Library at Oxford. The original version in German, dated 1764, is Mr. Westwood's copy, and the French, dated 1766, is Mr. Hope's.

"Les baguettes sont placées derrière les stigmates. La couleur jaune de l'une de ces baguettes (très grossie, pl. 4. fig. 3) est bien de beaucoup plus vive que celle des vésicules résonnantes [alulets], cependant elle paroît pourtant être faite de la même matière, du moins la tête de la baguette, *g*, et ne consiste qu'en une simple membrane, bordée d'un chassi, d'une matière un peu plus solide, qui les divise dans la même proportion en deux hémisphères. L'on voit encore mieux ces parties dans les Cousins qui de même que tous les insectes à deux ailes sont pourvus de ces baguettes et qui ont aussi deux vésicules résonnantes très petites, que dans les mouches, puisque les tiges des vessies presque transparentes sont plus longues. Aussitôt que nous examinons la vessie antérieure au travers d'une loupe nous ne pouvons faire aucune autre conclusion, si non, qu'elle soit creuse, ou pour mieux dire que ce soit une vessie enflée. Nous pouvons conjecturer la même chose ici par comparaison. Mais cette conjecture devient d'autant plus certaine, si nous examinons la baguette d'une mouche morte, où nous trouvons sa tête affaissée et contractée comme une vessie vuide d'air (pl. 3. fig. 27 *c*).

"Nous verrons dans la suite que cette cavité des baguettes est faite dans des desseins très importants. La verge [peduncle] garnie de poils très courts, ou la tige a le plus d'épaisseur près du corps; elle est inflexible, et *presque garrolé par en haut de plusieurs nerfs* [*oben mit vielen nerven als wie mit Schnüren umwickelt*; mit einem worte, so beschaffen, dass man ihm gleichsam seine Stärke ansieht]; en un mot, elle est faite de manière que l'on peut juger de sa force par les dehors."

The plates in both versions of the work are from the same coppers. In the figures of the *halteres* a rough view is given of the groups of vesicular projections at the base of those organs. The individual vesicles, however, are not represented as distinct from each other. By the "nerves," described as being outside, and as giving an idea of strength, I presume the author means "nervures," which he considers the rows of vesicles to be, and not nerves derived from the ganglionic centres.—J. B. H.

EXPLANATION OF THE PLATES.

(All the figures are magnified.)

TAB. XXVII.

- Fig. 1. Preparation from the wing of a Longicorn Beetle (*Strangalia elongata*), showing the subcostal nervure giving off branches passing to the vesicles: *t*, trachea; *n*, subcostal nervure.
- Fig. 2. Elytron of *Melolontha vulgaris*: *t*, trachea; *n*, nervure; *b*, portion more highly magnified, showing the termination of the nerves.

TAB. XXVIII.

- Fig. 1. Portion of the elytron of a species of *Carabus*: *a a*, trachea; *b b*, nerves proceeding to papillæ; *c c*, markings in elytron, probably solid between upper and under wall.
- Fig. 2. Portion of anterior wing of *Ophion luteus*: *a*, base of subcostal nervure, upper side; *b*, end of nervure; *c*, under side of nervure.
- Fig. 3. *Tenthredo viridis*. A, portion of anterior wing; *a*, upper, *b*, under side. B, portion of posterior wing; *a*, upper, *b*, under side. C, section of wall of nervure through the organs; diameter at surface $\frac{1}{8000}$ th of an inch.